ability to respond to changes in heat or cold, especially in persons with quadriplegia from spinal cord injuries.

It is important that athletic performance, which is well above average functional performance, be considered as the goal in diagnosing and treating the soft tissue injuries of the disabled athlete. Conditioning and strengthening after an injury must go well beyond the strength, power and endurance required for the performance of ordinary activities of daily life.

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Functional Electrical Stimulation

IN 400 BC Greek physicians recommended using the electric torpedo fish (family Torpedinidae) as a treatment for paralysis. In 1791 Galvani linked electrical stimulation to muscle contraction. Electrical stimulation was enthusiastically promoted in the 19th century for a variety of ailments, firmly establishing this modality in the pantheon of quackery.

Advances in electronics and neuromuscular physiology engendered more realistic applications of electrical stimulation. It is widely used as an adjunct to physical therapy (sometimes this specific clinical use is equated with all of functional electrical stimulation) and as a pain treatment modality (transcutaneous nerve stimulation). In 1961 Lieberson coined the term "functional electrotherapy" for electrical stimulation used in place of an ankle-foot orthosis for hemiplegic footdrop. Useful movement of the ankle dorsiflexors was produced by heel-switch gated stimulation of the peroneal nerve. Improvements in reliability, size, materials and computerization have led to portable and even implantable systems of remarkable sophistication. Notable are those devices for phrenic nerve stimulation, sacral root stimulation for micturition and peripheral nerve or motor point stimulation of upper extremities for hand function or the lower extremities for standing and ambulation. Strategies of sensory feedback are being investigated in some patients to give a more physiologic approximation of function.

The clinical application of these systems requires an experienced team including physicians, therapists and technicians. A fairly sophisticated level of patient and family cooperation is essential. The high current requirement and loss of neurotrophic factors in denervation (lower motor neuron paralysis) limit electrical stimulation to conditions where the motor units are intact (upper motor neuron paralysis). Extensive conditioning programs, in addition to standard rehabilitation, are needed to strengthen atrophic muscles and improve fatigue resistance of electrically stimulated muscles. This "functional electrical exercise" may have physiologic benefits in itself.

Media attention has tended to obscure the fact that these systems are electrical orthoses and do not cure underlying disease. They are appropriate only when the lower motor neuron is intact and may adversely affect recovery in cases of incomplete lower motor neuron disease. Despite this, functional electrical stimulation remains a rapidly evolving area of rehabilitation that in the near future may provide significant functional options for the severely disabled.

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Vocational Potential in Multiple Sclerosis

MULTIPLE SCLEROSIS affects an estimated 123,000 adults in the United States, and 90% have the onset of their disease in their vocational prime, between the ages of 15 and 50. Several studies have shown an unusually high level of educational accomplishment in this population, with almost half in one study having some postsecondary education. Yet, the incidence of unemployment in the multiple sclerosis population is extremely high, and the cost of this unemployment to society is considerable.

In a study done in the United States in 1981, less than 20% of patients with multiple sclerosis were still employed 20 years after diagnosis. In a study done in West Germany in 1965, nearly a third of the patients studied were still employed 20 years after diagnosis. Yet, an Israeli study from 1981 found that more than 50% of persons with multiple sclerosis continued to work, and the study population included the entire known group of persons with this disorder in Israel at that time. The reasons for the significant national differences in percentages of employed persons with multiple sclerosis are not known. There are substantial differences between American, Israeli and German cultures, but they share enough in common to warrant study to achieve the best possible level of employment, especially with the US rate falling more than 30% short of the highest rate found.

Many problems may create vocational difficulties for a person with multiple sclerosis. Visual problems, ataxia, fatigue, mobility problems, urinary urgency and frequency and cognitive problems all can be severely disabling on the job and cause a need for substantial job modification.

The frequency of cognitive problems in persons with multiple sclerosis is high. More than 50% of patients in one recent study tested in the impaired range despite a mean diagnosed length of illness of less than seven years. Of the cognitive deficits seen, many are of considerable vocational significance. They include many frontal lobe function problems such as the loss of abstract conceptualizing skills, short-term memory and new learning ability, as well as impaired concentration and reduced insight. These problems often are clinically silent. Failure to function cognitively may lead a person to leave a job but transfer the blame to "physical difficulty." A thorough evaluation of cognitive function is useful in assessing ability and disability and in planning a vocational rehabilitative strategy. Counseling may play a very helpful role in learning to cope with cognitive disability.

Urologic problems are frequently mentioned as a problem on a job. The commonest problems reported have been ur-